2

WSRC-MS--91-235

DE92 009431

RADIOACTIVE AND HAZARDOUS WASTEWATER TREATMENT AND SLUDGE STABILIZATION BY FILTRATION (U)

by

H. L. Martin

H. Lee Martin, Dr. John B. Pickett, and Dr. Christine A. Langton

Westinghouse Savannah River Co.
Savannah River Site
Aiken, South Carolina 29808

MAR 1 6 1992

A paper proposed for presentation at the
American Filtration Society 1991 National Meeting
College Park, Georgia
October 23, 1991

This paper was prepared in connection with work done under Contract No. DE-AC-09-89SR18035 with the U.S. Department of Energy. By acceptance of this paper, the publisher and/or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper, along with the right to reproduce and to authorize others to reproduce all or part of the copyrighted paper.

M91100121

RADIOACTIVE AND HAZARDOUS WASTEWATER TREATMENT AND SLUDGE STABILIZATION BY FILTRATION (U)

by

H L Martin

H. Lee Martin, Dr. John B. Pickett, and Dr. Christine A. Langton

WESTINGHOUSE SAVANNAH RIVER COMPANY
Aiken, SC 29808

INTRODUCTION

Fuel and target assemblies for the nuclear reactors of the Savannah River Site are fabricated in three production buildings and two support laboratories. In two of the buildings, uranium and lithium alloys of aluminum are cast, extruded, and drawn into long tubes with aluminum cladding. In the other building, short tubular-shaped uranium cores are nickel plated and clad in aluminum cans by hot-die-size bonding.

Dilute effluents from these metal finishing and aluminum forming operations flow to an end-of-pipe industrial wastewater treatment facility. Metal phosphates are removed by the EPA approved best available technology (BAT) that is economically achievable. Treatment consists of wastewater equalization, physical/chemical precipitation, flocculation, and pressure filtration. Insoluble metal oxides from an autoclave test effluent are removed by a separate wastewater equalization and pressure filtration system. The combined filtrates are analyzed and discharged to Tims Branch Creek.

Concentrated effluents from batch discharges of spent process solutions are mixed with filter cake from treatment of the dilute effluents and stored in a large tank at the optimum high pH for hydroxide precipitation of heavy metals. Supernate is decanted from the storage tanks and mixed with the dilute effluents before treatment. A filtration and stabilization (FIST) process has been developed to treat the stored sludge as well as the concentrated wastewater slurry as it is generated. A 94% waste volume reduction over conventional technology can be achieved. Furthermore, leachate from the solidified waste filter cake meets the EPA land disposal restrictions [Toxicity Control Leachate Procedure (TCLP) for F-006 waste].

DISCUSSION

Production lines and equipment that are the major sources of wastewater are shown in Table I. Uranium cores that have been pre-etched in nitric, phosphoric, and hydrochloric acids are nickel plated in a Watts bath. Aluminum tubes, caps, and cans are cleaned by degreasing in 1,1,2-trichlorotrifluoroethane, etching in caustic, desmuting in nitric acid, and surface treating in phosphoric acid. After aluminum forming operations are completed, quench water is used to cool the product. The finished product is then tested in steam autoclaves. Wastewater from failures contains uranium, nickel, and aluminum oxide particles. Some uranium cores are recovered from the rejected product by stripping of the aluminum and nickel cladding in caustic and nitric acid etch tanks. Air exhaust from hot nitric acid tanks is scrubbed in two-stage de-misters. Aluminum forming tools are degreased and etched in caustic.

The flow sheet of the M-Area Liquid Effluent Treatment Facility (LETF) is shown in Figure 1. It consists of three close-coupled facilities: the Dilute Effluent Treatment Facility (DETF); the Chemical Transfer Facility (CTF); and the Filtration and Stabilization (FIST) Facility that also processes sludge from the Interim Treatment/Storage Facility (IT/SF) tanks (not shown).

After a sodium hydroxide addition to adjust the concentrated wastewater slurry to the optimum for heavy metal precipitation in the FIST equalization tanks, treatability studies indicate that the most efficient and economical separation of dilute wastewater from the concentrated slurry can be achieved by a Verti-Press® filter. Cement will be added as a filter aid through an in-line static mixer located at the filter inlet. The Verti-Press® filter has horizontal platens with cleanable fabric belts and high pressure dewatering diaphragms suitable for uniform cake washing. TCLP analysis of the solidified cake from the pilot filter surpassed the Federal Land Ban best demonstrated available technology (BDAT) standard for listed F-006 hazardous waste. Nickel concentration in leachate was less than 0.05 mg/L compared to the 0.32 mg/L BDAT standard and to the 0.81 mg/L from conventional stabilization by cement, fly ash, and slag grout mixture. Uranium in this leachate was 1.22 mg/L and nitrate was 9.04 mg/L, also much less than from conventional stabilization of the sludge.

FIST filtrate and cake wash water is mixed with dilute wastewater from the production buildings in the DETF equalization tanks for treatment by acid, alum, and caustic to the optimum pH for precipitation of metal phosphates. Treated wastewater flows through an in-line static mixer for cationic polymer addition by a Stranco Poly-Blend® activation system. From the floc tank, the wastewater is fed to the Oberlin® pressure filters and is mixed with a high-flow perlite filter aid at the filter inlet. This mixture is distributed over a thin Tyvek® T-980 disposable filter media rated for 0.3 micron particle removal. The dried filter cake is mixed with the concentrated wastewater slurry that is treated and fed to the FIST filter. The filtrate is analyzed and discharged to a small surface stream. Very low NPDES permit discharge limits are reliably achieved, as shown in Table II.

Dilute wastewater contains only insoluble metal oxides when uranium targets fail in the steam autoclave test. This wastewater is fed to a separate filtration system and is mixed with a diatomaceous earth (DE) filter aid at the Oberlin® pressure filter inlet. Tyvek® T-980 disposable filter media is used. The filter cake is dissolved in waste acid and mixed with the concentrated wastewater slurry. To ensure submicron particle removal, the filtrate is pumped through a 0.5 micron cindered metal Mott® polishing filter. The cake is mixed with the feed to the Oberlin® filter where the fine particles become trapped in the DE pores. The filtrate is mixed with the DETF filtrate that is analyzed and discharged to the surface stream.

CONCLUSIONS

Composition of the concentrated wastewater sludge (38% wt solids) before filtration and the filtrate is shown in Table II. Pilot filter data indicate that a 100-square-feet filter area is needed to process the 2 gpm average flow of wastewater slurry. Composition of the dilute wastewater (containing the concentrated filtrate) and the dilute filtrate discharged to the stream is also shown in Table II. Two 24-square-feet filters separately process the dilute wastewater at an average flow of 15 gpm. TCLP analysis of the solidified waste filter cake is shown in Table III.

No nickel plating waste from production of uranium targets has been generated since 1987, and only stored waste supernate is now being treated and discharged. Contractor treatment of the stored sludge by the FIST process is being considered.

Table I. 300-M Area wastewater sources.

Three Production Buildings and Two Laboratories

- one nickel plating line
- five aluminum cleaning lines
- one slug quench operation
- one uranium slug autoclave test facility
- one aluminum/nickel stripping line
- two stack acid scrubbers
- one tool cleaning line

Table II. Wastewater composition.

	Sludge (mg/L)	Sludge Filtrate (mg/L)	Dilute Wastewater (mg/L)	Wastewater Filtrate (mg/L)
Uranium	2500	16.0	0.01	<0.01
Aluminum	5000	3100.0	286.0	0.176
Nickel	500	1.3	1.4	0.015
Lead	75	1.5	0.06	<0.013
Zinc	350	0.59	0.51	0.021
Copper	10	0.64	0.21	<0.002
Cadmium	-	5.6	<0.002	<0.002
Chromium	8	0.39	0.14	<0.002
Iron	200	5.4	5.4	0.012
Phosphate (as P)	1500	1100.0	26.0	12.0

Table III. TCLP analysis of filter cake.

	mg/L		mg/L
Uranium	1.22	Cadmium	<0.05
Arsenic	<0.5	Chromium	0.197
Nickel	<0.05	Selenium	<0.5
Lead	<0.5	Silver	<0.05
Zinc	<0.05	Barium	0.063
Mercury	<0.2	Nitrate (as N)	9.04

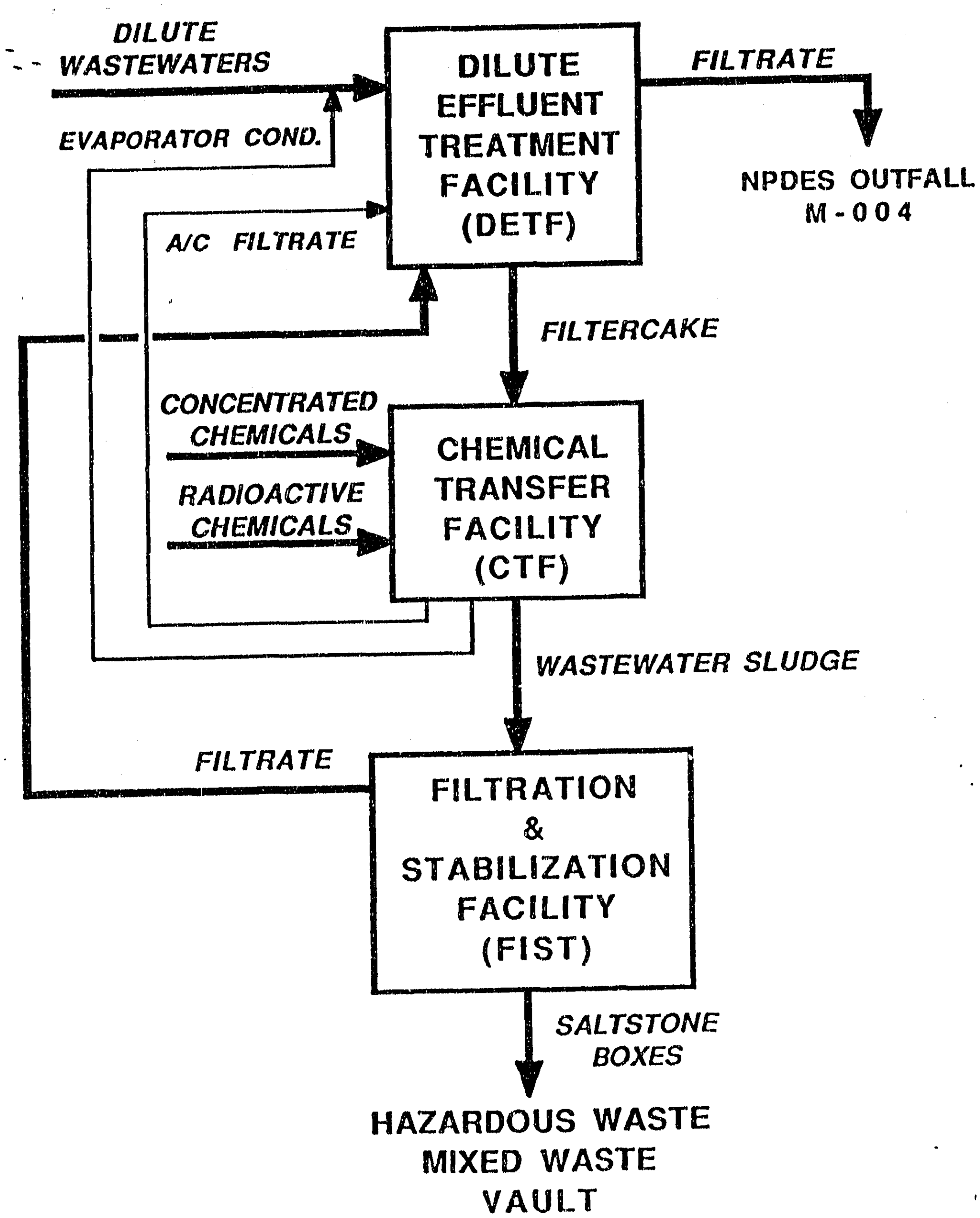

Figure 1. M-Area waste treatment flow sheet.

M9110012i

END

DATE
FILMED
5/05/92